

**Amendment and Response**

Serial No.: 10/032,049

Confirmation No.: 5131

Filed: December 21, 2001

For: METHODS FOR PLANARIZATION OF METAL-CONTAINING SURFACES USING HALOGENS AND HALIDE SALTS

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Page 6 of 14

**Remarks**

The Office Action mailed March 19, 2003 has been received and reviewed. Claims 10, 23, and 39 having been canceled and claims 1, 11, 18, 24, 37, 40, 52, and 53 having been amended, the pending claims are claims 1-9, 11-22, 24-38, and 40-53. Reconsideration and withdrawal of the rejections are respectfully requested.

Claims 1, 18, 37, 52, and 53 have been amended to incorporate language supported, for example, by claims 10-11, 23-24, and 39-40 (claims 10, 23, and 39 are now canceled). Claims 10, 23, and 39 having been canceled, claims 11, 24, and 40 have been amended to depend from claims 1, 18, and 37, respectively.

**Rejection under 35 U.S.C. §103**

The Examiner rejected claims 1-11 and 17 under 35 U.S.C. §103 as being unpatentable over U.S. Pat. No. 6,290,736 (Evans) in view of U.S. Pat. No. 6,395,184 (Russell et al.). Applicant respectfully traverses the rejection. The Examiner also rejected claims 12-16 and 18-51 under 35 U.S.C. §103 as being unpatentable over U.S. Pat. No. 6,290,736 (Evans) in view of U.S. Pat. No. 6,395,184 (Russell et al.) and further in view of U.S. Pat. No. 6,346,741 (Van Buskirk et al.). Applicant respectfully traverses the rejection. Claims 10, 23, and 39 have been canceled.

"To establish a *prima facie* case of obviousness . . . there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings." M.P.E.P. §706.02(j). "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. M.P.E.P. §2143.01 (section entitled "THE PROPOSED MODIFICATION CANNOT CHANGE THE PRINCIPLE OF OPERATION OF A REFERENCE"). "If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." M.P.E.P. §2143.01 (section

entitled "THE PROPOSED MODIFICATION CANNOT RENDER THE PRIOR ART UNSATISFACTORY FOR ITS INTENDED PURPOSE").

Applicant respectfully submits that claims 1-11 and 17 are patentable over U.S. Pat. No. 6,290,736 (Evans) in view of U.S. Pat. No. 6,395,184 (Russell et al.) and that claims 12-16 and 18-51 are patentable over U.S. Pat. No. 6,290,736 (Evans) in view of U.S. Pat. No. 6,395,184 (Russell et al.) and further in view of U.S. Pat. No. 6,346,741 (Van Buskirk et al.) for at least the reasons described herein below.

*Claims 1-50*

Independent claims 1, 18, 37 (as amended) each recite a planarization composition that includes a halogen-containing compound and a halide salt, *which are separately delivered*. The halogen-containing compound is selected from the group consisting of a *halogen*; an *interhalogen*; a halogen-generating compound selected from the group consisting of  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , *alkyl halides*, and *complexes of  $X_2$  with organic bases*; and combinations thereof.

Independent claims 31, 34, and 50 each recite a planarization composition that includes a halogen-containing compound and a halide salt, *which are separately delivered*. The halide salt is selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$ ,  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof. The halogen-containing compound is selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$  (i.e., *halogens*),  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$  (i.e., *interhalogens*),  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , *alkyl halides*, and *complexes of  $X_2$  with organic bases* (i.e., *halogen-generating compounds*), and combinations thereof.

*U.S. Pat. No. 6,290,736 (Evans)*

Evans neither discloses nor suggests a planarization composition including a halogen-containing compound and a halide salt that are separately delivered. Rather, as suggested by the Examiner in the Office Action mailed July 3, 2002 (e.g., page 3, lines 8-11),

any halide salt that *may be present* is formed only as a result of the reaction of a halogen with a strongly basic aqueous solution (e.g., NaOH or KOH) to form (i.e., *in situ*) the halide salt.

*U.S. Pat. No. 6,395,184 (Russell et al.)*

Russell et al. disclose a planarization composition including 12-18% by weight of a halide salt (e.g., ammonium bromide), 4-6% by weight of a halogen-containing compound (e.g., potassium bromate), and 1-4% citric acid (e.g., column 5, lines 40-52). "Ammonium bromide ( $\text{NH}_4\text{Br}$ ) is . . . added to (i) maintain the concentration of active bromine in solution . . . , and (ii) provide ammonium ion ( $\text{NH}_4$ ) that reacts with the citric acid" (column 5, line 64 to column 6, line 2). "Citric acid . . . functions as an acid initiator. The acid works to promote decomposition of the bromate and thus provide the solution with its source of reactive bromine" (column 6, lines 12-15).

However, Russell et al. neither disclose nor suggest a planarization composition including a halogen-containing compound and a halide salt that are separately delivered, wherein the halogen-containing compound is selected from the group consisting of  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$ ,  $\text{ClBr}$ ,  $\text{IBr}$ ,  $\text{ICl}$ ,  $\text{BrF}$ ,  $\text{ClF}$ ,  $\text{ClF}_3$ ,  $\text{BrF}_3$ ,  $\text{ClF}_5$ ,  $\text{IF}_5$ ,  $\text{IF}_7$ ,  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases, and combinations thereof (e.g., claims 31-36 and 50), or wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases; and combinations thereof (e.g., claims 1-9, 11-22, 24-30, 37-38, and 40-49).

Further, Applicant wishes to bring to the Examiner's attention a preferred embodiment of the present invention, which includes about 1% to about 10% by weight halide salt in the planarization composition (e.g., claims 33, 36, and 48). Applicant respectfully submits that Russell et al., which recite 12-18% by weight of a halide salt, fail to disclose or suggest a planarization composition including about 1% to about 10% by weight halide salt.

*Evans Cannot be Modified by Russell et al. Without Changing the Principle of Operation .*

The Examiner urged that it would have been obvious to combine the halide salt of Russell et al. and Evans CMP method. However, Applicant respectfully points out that, as described herein above, Evans requires a strongly basic aqueous solution (e.g., NaOH or KOH) to form (i.e., *in situ*) a halide salt. In contrast, Russell et al. requires an acid initiator to promote decomposition of the bromate and thus provide the solution with its source of reactive bromine. Russell et al. further adds a halide salt to maintain the concentration of active bromine in solution.

Thus, Evans cannot be modified by Russell et al. without changing the principle of operation. For example, Evans forms a halide salt *in situ* from the reaction of bromine in a basic solution, while Russell et al. add a halide to maintain the concentration of bromine in an acidic solution. Therefore, the modification of Evans by Russell et al. changes the principle of operation, and there is no suggestion or motivation to modify Evans by Russell et al.

*Evans and Russell et al. Cannot Be Combined Without Rendering Them Unsatisfactory for Their Intended Purposes.*

As described herein above, Evans requires a strongly basic aqueous solution (e.g., NaOH or KOH) to form (i.e., *in situ*) a halide salt. In contrast, Russell et al. requires an acid initiator to promote decomposition of the bromate and thus provide the solution with its source of reactive bromine. Thus, one of skill in the art would have no motivation to combine Evans and Russell et al.

Furthermore, if one attempted to combine Evans and Russell et al. in an acidic composition, then the resulting composition would fail to form a halide salt *in situ*, rendering Evans unsuitable for its intended purpose. Similarly, if one attempted to combine Evans and Russell et al. in a basic composition, then the resulting composition would fail to promote the decomposition of bromate and provide a source of reactive bromine, rendering Russell et al.

unsuitable for its intended purpose. Thus, there is no suggestion or motivation to make the proposed combination or modification.

*U.S. Pat. No. 6,436,741 (Van Buskirk et al.)*

Applicant respectfully submits that U.S. Pat. No. 6,436,741 (Van Buskirk et al.), which discloses polishing media that includes halide salts (e.g., column 13, lines 17-25), adds nothing to correct the deficiencies of Evans in view of Russell et al. as described herein above.

Applicant respectfully requests that the rejections of claims 1-11 and 17 over Evans in view of Russell et al., and claims 12-16 and 18-50 over Evans in view of Russell et al. and further in view of Van Buskirk et al. be reconsidered and withdrawn.

*Independent Claim 51*

"To establish a *prima facie* case of obviousness . . . the prior art reference (or references when combined) must teach or suggest all the claim limitations." M.P.E.P. §706.02(j).

Independent claim 51 recites a planarization composition that includes a halogen-containing compound and a halide salt, *which are separately delivered*. The halide salt is selected from the group consisting of *NaI, KCl, KBr, NH<sub>4</sub>F, Et<sub>4</sub>NBr, Me<sub>3</sub>NHCl, Me<sub>4</sub>NF*, and combinations thereof. The halogen-containing compound is selected from the group consisting of *ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>* (i.e., *interhalogens*), *XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>*, alkyl halides, and complexes of *X<sub>2</sub>* with organic bases (i.e., *halogen-generating compounds*), and combinations thereof. Notably, the recited halogen-containing compounds *do not include halogens*.

Applicant respectfully submits that independent claim 51 is patentable over Evans in view of Russell et al. further in view of Van Buskirk et al. for at least the reasons recited herein above for the patentability of claims 1-50.

Furthermore, Evans in view of Russell et al. further in view of Van Buskirk et al. fail to disclose or suggest a halogen-containing compound selected from the group consisting of *ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>* (i.e., interhalogens), *XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>6</sub>, alkyl halides, and complexes of X<sub>2</sub> with organic bases* (i.e., halogen-generating compounds), and combinations thereof.

For at least the reasons presented herein above, Applicant respectfully submits that the Examiner has failed to establish a *prima facie* case of obviousness, and that claim 51 is patentable over Evans in view of Russell et al. further in view of Van Buskirk et al.

*Independent Claim 52*

The Examiner rejected claim 52 under 35 U.S.C. §103 as being unpatentable over U.S. Pat. No. 6,290,736 (Evans) in view of U.S. Pat. No. 6,346,741 (Van Buskirk et al.). Applicant respectfully traverses the rejection.

Independent claim 52 (as amended) recites a planarization composition that includes a halogen-containing compound and a halide salt, *wherein the halogen of the halogen-containing compound is different than the halogen of the halide salt*. The halogen-containing compound is selected from the group consisting of a *halogen*; an *interhalogen*; a halogen-generating compound selected from the group consisting of *XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>6</sub>, alkyl halides, and complexes of X<sub>2</sub> with organic bases*; and combinations thereof.

Evans, which has been discussed herein above, fails to disclose or suggest a planarization composition including a halogen-containing compound and a halide salt that are separately delivered. Rather, as suggested by the Examiner in the Office Action mailed July 3, 2002 (e.g., page 3, lines 8-11), any halide salt that *may be present* is formed only as a result of the reaction of a halogen with a strongly basic aqueous solution (e.g., NaOH or KOH) to form (i.e., *in situ*) the halide salt.

Applicant respectfully submits that Van Buskirk et al., which discloses polishing media that includes halide salts (e.g., column 13, lines 17-25), fail to correct the deficiencies of Evans. For example, Van Buskirk et al. lack, among other things, a disclosure or suggestion of a planarization composition including a halogen-containing compound and a halide salt, wherein the halogen-containing compound is selected from the group consisting of a *halogen*; an *interhalogen*; a halogen-generating compound selected from the group consisting of  $XeF_2$ ,  $HgF_2$ ,  $SF_6$ , *alkyl halides*, and *complexes of  $X_2$  with organic bases*; and combinations thereof (e.g., claim 52).

Furthermore, Van Buskirk et al. fail to specifically disclose or suggest the combination of a halogen-containing compound and a halide salt, *wherein the halogen of the halogen-containing compound is different than the halogen of the halide salt*. Moreover, although Van Buskirk et al. disclose compositions that "include  $H_2O_2$ ,  $K_3Fe(CN)_6$ ,  $K_3Fe(C_2O_4)_3$ ,  $Fe(C_2H_3O_2)_3$ ,  $Fe(NO_3)_3$ ,  $Fe_2(SO_4)_3$ ,  $Fe(OH)_3$ ,  $(NH_4)_3Fe(CN)_6$ ,  $(NH_4)_3Fe(C_2O_4)_3$ , KCl, KBr, KI,  $FeCl_3$ ,  $FeBr_3$ ,  $FeI_3$ ,  $FeCl_2$ ,  $FeBr_2$ , and  $FeI_2$ , and combination of two or more of the foregoing" (column 13, lines 17-25), they fail to provide any guidance for one of skill in the art to select, from the above recited list of 18 species (including 3 halide salts, i.e., KCl, KBr, KI; and 6 non-halide halogen containing compounds, i.e.,  $FeCl_3$ ,  $FeBr_3$ ,  $FeI_3$ ,  $FeCl_2$ ,  $FeBr_2$ , and  $FeI_2$ ), a combination of two species ( $18 \times 17 = 306$  total combinations of two different species), the specific combination of a halogen-containing compound and a halide salt, *wherein the halogen of the halogen-containing compound is different than the halogen of the halide salt* (12 combinations of the two recited species: KCl+ $FeBr_3$ ; KCl+ $FeI_3$ ; KCl+ $FeBr_2$ ; KCl+ $FeI_2$ ; KBr+ $FeCl_3$ ; KBr+ $FeI_3$ ; KBr+ $FeCl_2$ ; KBr+ $FeI_2$ ; KI+ $FeCl_3$ ; KI+ $FeBr_3$ ; KI+ $FeCl_2$ ; and KI+ $FeBr_2$ ).

For at least the reasons presented herein above, Applicant respectfully submits that claim 52 is patentable over Evans in view of Van Buskirk et al.

*Independent Claim 53*

The Examiner rejected claim 53 under 35 U.S.C. §103 as being unpatentable over U.S. Pat. No. 6,290,736 (Evans) in view of U.S. Pat. No. 6,395,184 (Russell et al.) and further in view of U.S. Pat. No. 5,976,928 (Kirlin et al.). Applicant respectfully traverses the rejection.

Independent claim 53 (as amended) recites a planarization composition that includes a halogen-containing compound and a halide salt, *wherein the planarization composition is not basic*. The halogen-containing compound is selected from the group consisting of a *halogen*; an *interhalogen*; a halogen-generating compound selected from the group consisting of  $XeF_2$ ,  $HgF_2$ ,  $SF_6$ , *alkyl halides*, and *complexes of  $X_2$  with organic bases*; and combinations thereof.

As discussed herein above, Evans in view of Russell et al. fails to disclose or suggest a planarization composition that includes a halide salt and a halogen-containing compound selected from the group consisting of a *halogen*; an *interhalogen*; a halogen-generating compound selected from the group consisting of  $XeF_2$ ,  $HgF_2$ ,  $SF_6$ , *alkyl halides*, and *complexes of  $X_2$  with organic bases*; and combinations thereof.

Applicant respectfully submits that Kirlin et al., which discloses acidic or basic aqueous solutions as CMP slurry compositions for *insulating inorganic metal oxides* (column 5, lines 4-16), adds nothing to correct the deficiencies of Evans in view of Russell et al. For example, Kirlin et al. lack, among other things, a disclosure or suggestion of a planarization composition for a *metal-containing surface including a metal selected from a Group VIII B metal, a Group IB metal*, and a combination thereof; and a planarization composition that includes *a halide salt and a halogen-containing compound* (e.g., claim 53). Thus, one of skill in the art would have no motivation to combine Kirlin et al. with Evans in view of Russell et al.

Thus, Kirlin et al. cannot be combined with Evans in view of Russell et al. to give the presently claimed invention (e.g., claim 53). For at least the reasons presented herein above, Applicant respectfully submits that claim 53 is patentable over Evans in view of Russell et al. further in view of Kirlin et al.



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Page 14 of 14

In view of the remarks presented herein above, Applicant respectfully requests that the Examiner reconsider and withdraw the rejections under 35 U.S.C. §103.

**Summary**

It is respectfully submitted that all the pending claims are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicant's Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for

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The undersigned hereby certifies that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Mail Stop RCE, P.O. Box 1450, Alexandria, VA 22313-1450.

By: 

Name: GARA LADWIG

APPENDIX A - SPECIFICATION/CLAIM AMENDMENTS  
INCLUDING NOTATIONS TO INDICATE CHANGES MADE

Serial No.: 10/032,049

Docket No.: 150.01180101

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Amendments to the following are indicated by underlining what has been added and bracketing what has been deleted. Additionally, all amendments have been indicated by the use of bold font.

**In the Claims**

For convenience, all pending claims are shown below.

1. **(Amended)** A planarization method comprising:  
positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;  
supplying a planarization composition in proximity to the interface; and  
planarizing the substrate surface;  
wherein the planarization composition comprises a halogen-containing compound and a halide salt, which are separately delivered; **and**  
**wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>6</sub>, alkyl halides, and complexes of X<sub>2</sub> with organic bases; and combinations thereof.**
2. The method of claim 1 wherein the metal-containing surface of the substrate comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof, which is in elemental form or an alloy thereof.
3. The method of claim 1 wherein the metal-containing surface of the substrate comprises a metal selected from the group consisting of a Group VIIIB second row metal, a Group

VIIIIB third row metal, a Group IB second row metal, a Group IB third row metal, and a combination thereof.

4. The method of claim 3 wherein the metal-containing surface of the substrate comprises a metal selected from the group consisting of Rh, Pd, Pt, Ir, and Ru.
5. The method of claim 4 wherein the metal-containing surface comprises elemental platinum.
6. The method of claim 1 wherein the metal is present in an amount of about 50 atomic percent or more.
7. The method of claim 1 wherein the substrate is a semiconductor substrate or substrate assembly.
8. The method of claim 1 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
9. The method of claim 1 which is carried out in one step.
10. **Canceled**
11. **(Amended)** The method of claim 1[10] wherein the halogen-containing compound is selected from the group consisting of F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, I<sub>2</sub>, ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>, XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of X<sub>2</sub> with organic bases, and combinations thereof.

12. The method of claim 1 wherein the halide salt is an inorganic salt.
13. The method of claim 12 wherein the inorganic halide salt is selected from the group consisting of NaI, KCl, KBr, NH<sub>4</sub>F, and combinations thereof.
14. The method of claim 1 wherein the halide salt is an organic salt.
15. The method of claim 14 wherein the organic salt is selected from the group consisting of Et<sub>4</sub>NBr, Me<sub>3</sub>NHCl, Me<sub>4</sub>NF, and combinations thereof.
16. The method of claim 1 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
17. The method of claim 1 wherein the polishing surface comprises a fixed abrasive article.
18. **(Amended)** A planarization method comprising:
  - providing a semiconductor substrate or substrate assembly including at least one region of a platinum-containing surface;
  - providing a polishing surface;
  - providing a planarization composition at an interface between the at least one region of platinum-containing surface and the polishing surface; and
  - planarizing the at least one region of platinum-containing surface;wherein the planarization composition comprises a halogen-containing compound and a halide salt, which are separately delivered; **and**

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Serial No.: 10/032,049

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For: METHODS FOR PLANARIZATION OF METAL-CONTAINING SURFACES USING HALOGENS AND HALIDE SALTS

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wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases; and combinations thereof.

19. The method of claim 18 wherein the platinum-containing surface of the substrate comprises platinum in elemental form.
20. The method of claim 18 wherein the platinum is present in an amount of about 50 atomic percent or more.
21. The method of claim 18 wherein the semiconductor substrate or substrate assembly is a silicon wafer.
22. The method of claim 18 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.
23. **Canceled**
24. **(Amended)** The method of claim 18[23] wherein the halogen-containing compound is selected from the group consisting of  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$ ,  $\text{ClBr}$ ,  $\text{IBr}$ ,  $\text{ICl}$ ,  $\text{BrF}$ ,  $\text{ClF}$ ,  $\text{ClF}_3$ ,  $\text{BrF}_3$ ,  $\text{ClF}_5$ ,  $\text{IF}_5$ ,  $\text{IF}_7$ ,  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases, and combinations thereof.
25. The method of claim 18 wherein the halide salt is an inorganic salt.

26. The method of claim 25 wherein the inorganic halide salt is selected from the group consisting of NaI, KCl, KBr,  $\text{NH}_4\text{F}$  and combinations thereof.
27. The method of claim 18 wherein the halide salt is an organic salt.
28. The method of claim 27 wherein the organic salt is selected from the group consisting of  $\text{Et}_4\text{NBr}$ ,  $\text{Me}_3\text{NHCl}$ ,  $\text{Me}_4\text{NF}$ , and combinations thereof.
29. The method of claim 18 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight and the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.
30. The method of claim 18 wherein the polishing surface comprises a fixed abrasive article.
31. A planarization method comprising:
  - positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;
  - supplying a planarization composition in proximity to the interface; and
  - planarizing the substrate surface;
    - wherein the planarization composition comprises:
      - a halogen-containing compound selected from the group consisting of  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$ ,  $\text{ClBr}$ ,  $\text{IBr}$ ,  $\text{ICl}$ ,  $\text{BrF}$ ,  $\text{ClF}$ ,  $\text{ClF}_3$ ,  $\text{BrF}_3$ ,  $\text{ClF}_5$ ,  $\text{IF}_5$ ,  $\text{IF}_7$ ,  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases, and combinations thereof; and
      - a halide salt selected from the group consisting of NaI, KCl,

KBr,  $\text{NH}_4\text{F}$ ,  $\text{Et}_4\text{NBr}$ ,  $\text{Me}_3\text{NHCl}$ ,  $\text{Me}_4\text{NF}$ , and combinations thereof;  
wherein the halogen-containing compound and the halide salt  
are separately delivered.

32. The method of claim 31 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.
33. The method of claim 31 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.
34. A planarization method comprising:
  - providing a semiconductor substrate or substrate assembly including at least one region of a platinum-containing surface;
  - providing a polishing surface;
  - providing a planarization composition at an interface between the at least one region of platinum-containing surface and the polishing surface; and
  - planarizing the at least one region of platinum-containing surface;
    - wherein the planarization composition comprises:
      - a halogen-containing compound selected from the group consisting of  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$ ,  $\text{ClBr}$ ,  $\text{IBr}$ ,  $\text{ICl}$ ,  $\text{BrF}$ ,  $\text{ClF}$ ,  $\text{ClF}_3$ ,  $\text{BrF}_3$ ,  $\text{ClF}_5$ ,  $\text{IF}_5$ ,  $\text{IF}_7$ ,  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases, and combinations thereof; and
      - a halide salt selected from the group consisting of  $\text{NaI}$ ,  $\text{KCl}$ ,  $\text{KBr}$ ,  $\text{NH}_4\text{F}$ ,  $\text{Et}_4\text{NBr}$ ,  $\text{Me}_3\text{NHCl}$ ,  $\text{Me}_4\text{NF}$ , and combinations thereof;
    - wherein the halogen-containing compound and the halide salt are separately delivered.

35. The method of claim 34 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.
36. The method of claim 34 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.
37. **(Amended)** A planarization method for use in forming an interconnect, the method comprising:
- providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;
  - positioning a first portion of a polishing surface for contact with the metal-containing layer;
  - providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and
  - planarizing the metal-containing layer;
- wherein the planarization composition comprises a halogen-containing compound and a halide salt, which are separately delivered; **and**
- wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_6$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases; and combinations thereof.**
38. The method of claim 37 wherein the polishing surface comprises a polishing pad and the planarization composition comprises a plurality of abrasive particles.



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For: METHODS FOR PLANARIZATION OF METAL-CONTAINING SURFACES USING HALOGENS AND HALIDE SALTS

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39. **Canceled**
40. **(Amended)** The method of claim 37[39] wherein the halogen-containing compound is selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$  with organic bases, and combinations thereof.
41. The method of claim 37 wherein the halide salt is an inorganic salt.
42. The method of claim 41 wherein the inorganic halide salt is selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$  and combinations thereof.
43. The method of claim 37 wherein the halide salt is an organic salt.
44. The method of claim 43 wherein the organic salt is selected from the group consisting of  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof.
45. The method of claim 37 wherein the halogen-containing compound is present in the planarization composition in an amount of at least about 0.1% by weight.
46. The method of claim 45 wherein the halogen-containing compound is present in the planarization composition in an amount of about 1% to about 10% by weight.
47. The method of claim 37 wherein the halide salt is present in the planarization composition in an amount of at least about 0.1% by weight.

48. The method of claim 47 wherein the halide salt is present in the planarization composition in an amount of about 1% to about 10% by weight.
49. The method of claim 37 wherein the polishing surface comprises a fixed abrasive article.
50. A planarization method for use in forming an interconnect, the method comprising:  
    providing a semiconductor substrate or substrate assembly having a patterned dielectric layer formed thereon and a metal-containing layer formed over the patterned dielectric layer, wherein the metal-containing layer comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;  
    positioning a first portion of a polishing surface for contact with the metal-containing layer;  
    providing a planarization composition in proximity to the contact between the polishing surface and the metal-containing layer; and  
    planarizing the metal-containing layer;  
    wherein the planarization composition comprises:  
        a halogen-containing compound selected from the group consisting of  $F_2$ ,  $Cl_2$ ,  $Br_2$ ,  $I_2$ ,  $ClBr$ ,  $IBr$ ,  $ICl$ ,  $BrF$ ,  $ClF$ ,  $ClF_3$ ,  $BrF_3$ ,  $ClF_5$ ,  $IF_5$ ,  $IF_7$ ,  $XeF_2$ ,  $HgF_2$ ,  $SF_4$ , alkyl halides, and complexes of  $X_2$  with organic bases, and combinations thereof; and  
        a halide salt selected from the group consisting of  $NaI$ ,  $KCl$ ,  $KBr$ ,  $NH_4F$ ,  $Et_4NBr$ ,  $Me_3NHCl$ ,  $Me_4NF$ , and combinations thereof;  
    wherein the halogen-containing compound and the halide salt are separately delivered.
51. A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

supplying a planarization composition in proximity to the interface;

and

planarizing the substrate surface;

wherein the planarization composition comprises:

a halogen-containing compound selected from the group consisting of ClBr, IBr, ICl, BrF, ClF, ClF<sub>3</sub>, BrF<sub>3</sub>, ClF<sub>5</sub>, IF<sub>5</sub>, IF<sub>7</sub>, XeF<sub>2</sub>, HgF<sub>2</sub>, SF<sub>4</sub>, alkyl halides, and complexes of X<sub>2</sub> with organic bases, and combinations thereof; and

a halide salt selected from the group consisting of NaI, KCl, KBr, NH<sub>4</sub>F, Et<sub>4</sub>NBr, Me<sub>3</sub>NHCl, Me<sub>4</sub>NF, and combinations thereof;

wherein the halogen-containing compound and the halide salt are separately delivered.

52. **(Amended)** A planarization method comprising:

positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;

supplying a planarization composition in proximity to the interface; and

planarizing the substrate surface;

wherein the planarization composition comprises a halogen-containing compound and a halide salt; **and further]**

wherein the halogen of the halogen-containing compound is different than the halogen of the halide salt; **and**

wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases; and combinations thereof.

53. (Amended) A planarization method comprising:

- positioning a metal-containing surface of a substrate to interface with a polishing surface, wherein the metal-containing surface comprises a metal selected from the group consisting of a Group VIIIB metal, a Group IB metal, and a combination thereof;
- supplying a planarization composition in proximity to the interface; and
- planarizing the substrate surface;

wherein the planarization composition comprises a halogen-containing compound and a halide salt;[, and further]

wherein the planarization composition is not basic; and

wherein the halogen-containing compound is selected from the group consisting of a halogen; an interhalogen; a halogen-generating compound selected from the group consisting of  $\text{XeF}_2$ ,  $\text{HgF}_2$ ,  $\text{SF}_4$ , alkyl halides, and complexes of  $\text{X}_2$  with organic bases; and combinations thereof.